Chapter 2

Professional Devotion, National Needs, Fascist Claims, and Democratic Virtues

The Language of Science Policy in Germany

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In the second half of the twentieth century, "basic and applied research" became predominant and internationally acknowledged key concepts of science policy. Modern antonyms such as "pure and applied science" or "basic and applied research" spread across borders. However, the uses of these concepts, their discursive functions, and their ascriptions varied according to divergent national settings. This chapter is interested in the German particularities of the discourses revolving around these terms. What is special about the German concepts of *Grundlagenforschung* (basic research) and *angewandte Forschung* (applied research)? What did German scientists, politicians, and other experts mean when they used these terms? How did the concepts affect research policy and the overall understanding of science?

In the nineteenth century, Germany became a role model for leading science nations. The institutionalization of the natural sciences at German universities from the early nineteenth century onward was a success story. Experimental training and research units at German universities attracted more and more international students, particularly in chemistry and physics. One key to this successful professionalization lay in the fact that nineteenth-century natural scientists wholeheartedly embraced the academic ideal of pure science. After World War II, scientists in the Federal Republic of Germany,[1] who were striving to catch up with Western scientific standards, were dedicated to the idea of independent science and basic research to a similar extent. They even clung to the concept of basic research until the 1990s, when their colleagues in the United States—the leading science nation of the twentieth century—had long been converted to advocates of the applied side of research. What at first glance seems to point to a persistent German idealism of science—interrupted by the Nazi regime—on closer inspection turns out to be a history with several twists.

We argue that the shift from pure science to basic research was not a linear one. Moreover, the new concept of basic research cannot be seen as a simple conceptual variation of the older idea of pure science. Already in the first half of the twentieth century, the increasing industrial and governmental demand for research challenged the ideal of pure science. The support for science—that is, the institutional and financial underpinnings of a research landscape that became more and more differentiated—had to be renegotiated, and it was exactly in this period that neologisms such as *Grundlagenforschung, Zweckforschung* (goal-oriented research), and *Gemeinschaftsforschung* (collaborative research) emerged.

With regard to the specific national settings, the political history of Germany is distinctive for this case study. The Treaty of Versailles affected German science policy both directly, due to restrictions on German research by the allies, and indirectly, due to the following economic crisis and international isolation. After 1933, the academic elites were initially met with great hostility by the National Socialist Party. The racist personnel policy expelled many talented researchers from the German research landscape. It was only later that the Nazi regime pinned its hopes on research that was promising for armament improvements and conducive to its autarky policy. After the end of World War II, the allies regained control over German research activities. In contrast to 1918, however, they sought to integrate the Federal Republic into the Western world, and science soon became an integral part of the ensuing efforts at democratization and economic recovery. Yet, in addition to these political settings, Germany's specific academic culture and philosophical traditions dating back to the nineteenth century have to be taken into account to grasp the meanings and discursive role of German concepts of science policy.

Against this historical background, this chapter traces the emergence of the concepts of basic and applied research in Germany as part of a broader and historically grown semantic field. The chapter starts with a short history of the concepts of pure and applied science in the nineteenth and early twentieth centuries. The next section focuses on the Nazi period, when the term *Grundlagenforschung* gained importance for the first time as a political concept. In the following section, we discuss the semantic pluralism right after World War II, in which the transformation from fascism to democracy determined German science policy. Afterward, we show how "basic research" prevailed as an unofficial funding rationale that adopted the idea of pure and independent science and, at the same time, conveyed the promise of economic prosperity. Then we analyze the role of applied research and how it slowly gained importance in the shadow of basic research. The final section concludes by discussing the specifics of how German scientists and policy makers used "basic and applied research" and related concepts. We therefore contrast our main findings with the existing literature on science policies in other Western countries.

From Academic Identity to National Needs

The historical development from the nineteenth-century academic ideal of pure science to "basic research" as a multifunctional symbol of science policy in the twentieth century is not a linear one. Quite the contrary, the notion of science and the societal expectations toward science were constantly shifting, which caused several twists in this history. When natural scientists started to enter the universities in the late eighteenth century and in the nineteenth century, they had to come to terms with the philosophical understanding of science, which focused on theoretical, pure knowledge. This even applied to new German institutions of higher education, such as the *Bergakademie,* which responded to the policy of mercantilism and cameralism and its demand for experts in mining, forestry, and engineering (Klein 2010: 441). Natural sciences such as chemistry, which were based on empirical and experimental work, thus had to prove that they could produce theorems meant to be imparted to students (Meinel 1981).

This academic definition of science was backed up by the German traditions of *Erkenntnistheorie* (epistemology), in which rationalist approaches were ranked higher than the empirical ones. Immanuel Kant defined the natural sciences as pure science only because they are based on "a priori" conceptualizations of nature, such as assumptions on cause and effect (Kant 1869: 46–84). Consequently, Kant turned the religiously coined notion of laws of nature into a secularized ideal of the human reason that applies rules to bring order into the external world (Hampe 2007: 76–79). In the early nineteenth century, this longing for the wholeness and absoluteness of ideas gave birth to a new generation of natural philosophers, who had a big impact on German natural scientists' notion of science (Phillips 2012). These philosophers clung to the epistemic hierarchy according to which "a posteriori" approaches played a subordinated role in contrast to metaphysical ways of knowing. Natural philosophers like Friedrich Schelling (1831: 10) argued that science had to venture into the unknown before any considerations of utility or application.

In sum, the new academic setting and the leading discourse in philosophy formed the identity of German natural scientists based on the ideal of pure science and its respective academic virtues. Due to the early establishment of the natural sciences at universities, German scientists adapted perfectly to the idea of *Wissenschaft* (science), which comprises all academic disciplines from what we would call the humanities today to the natural sciences and was later considered a peculiarity of German science (Meyer 2012; Phillips 2015).

This predominant epistemic ideal also had an impact on the way scholars and scientists depicted the relationship between science and technology at that time as implying a belief in deducing endless applications and specific knowledge from universal principles. This process of knowledge transfer was alleged to be one-directional. In nineteenth-century Germany, technology counted as one possible application of science; it was therefore commonly defined as *angewandte Naturwissenschaft* (applied natural sciences). Even economists assumed that only scientific discoveries and theories paved the way for inventions or technical improvements. In his handbook on politics and government, the economist Constantin Rössler (1857: 179) argued that "Technical science may stimulate pure science to a certain extent, but, on the whole, technology is much more at the receiving end. Pure science is always further ahead of applied science, and never the other way round. However, technology finally turns science into a common good."[2] In the course of the nineteenth century, this model of the science-technology nexus became particularly relevant for the advancement of technical training. Scientific training of engineers in early trade and polytechnic schools gained more and more importance in the curriculum. In the heyday of German industrialization, the appreciation for engineers by society was growing rapidly, and teachers in engineering schools started to strive for academic status (Lundgreen 1990: 57–58; König 1999). In the last third of the nineteenth century, most German states therefore established *Technische Hochschulen*[3] (Manegold 1989: 219–231). Having scarcely assumed their place as pure science within a university, natural scientists felt professionally challenged by the academic ambitions of the engineering sciences. Thus, this is the time when natural scientists started to use the hierarchical distinction between "pure" and "applied science" as a means of professional "boundary work" (Gieryn 1999: 51–62). Within the hierarchical order of disciplines, the attribute "applied" placed engineering sciences in a subordinate position.

However, scientists and engineers not only competed for academic status but also for societal support and acknowledgement. Scientists became aware that, in comparison to the visible impact of technological developments on national prosperity, the advancement of science and its effects were less visible and predictable (e.g., Liebig 1862: 33). Therefore, scientists praised the utility of science by arguing that only scientific discoveries of the laws of nature laid the ultimate cornerstone for technical progress (e.g., Virchow 1877: 8–9). Defining technology and engineering sciences as "applied science" thus worked as a promotional strategy with which the natural sciences claimed their share in material benefits. This public rhetoric, however, contrasted with the identity of scientists dedicated to "science for its own sake." Hence, it was right in the heyday of the pure science ideal that scientists began to narrow the image of scientific utility to the promise of technological progress.

Within the German community of engineers, the distinction between "pure" natural sciences and "applied" technical sciences was quite contested. While the label "applied sciences" ennobled modern technology and stressed the academic aspirations of engineers, their representatives at the new *Technische Hochschulen* were engaged in a debate about the right proportion of theoretical knowledge—mainly deriving it from the natural sciences—and practical teaching units (Heymann 2005: 58–82; König 2014). Moreover, these new professors gained in self-assurance and advanced the view that technology contributed to the progress of science just like science helped to improve technology (Riedler 1900: 12).

Actually, in the late German *Kaiserreich,* when industrial demand for scientific research was increasing significantly, the ideal of pure science began to lose its rhetorical power. Scientists, especially chemists, who had become used to interacting with the nonacademic, economic sphere, tried to flatten the hierarchy between pure and applied science by emphasizing the similarities of the scientific and technological endeavor. This was, essentially, the systematic approach to research and the desire to venture into the unknown. According to Wilhelm Ostwald, a Nobel laureate and a pioneer of physical chemistry, scientists differed from engineers only in their long-term goal of finding final explanations, whereas engineers abandoned the path of scientific questioning after having found new technological solutions (Ostwald 1905; 1908). This phenomenon of blurring the boundaries was restricted to research fields that were highly relevant to industry. In the academic hierarchy, universities representing "pure science" still ranked higher than *Technische Hochschulen* did.

In the early twentieth century, the German research landscape and national science policy began to change more generally: *Wissenschaftspolitik* (science policy), which used to focus on aspects of higher education, subsequently was complemented by *Forschungspolitik* (research policy) that aimed at organizing scientific knowledge production in favor of national and industrial needs (Szöllösi-Janze 2005; Stichweh 2013: 135–138). In 1911, a new research organization, the Kaiser-Wilhelm-Gesellschaft (KWG, Kaiser Wilhelm Society), was founded. Financed by industry and the German government, it responded directly to the rising industrial demand for research by establishing new institutes outside of universities focused entirely on research. Originally, its founding father wanted the KWG to be devoted exclusively to the natural sciences (Harnack [1909] 2001). The KWG institutes were detached from the established university system and run by academically renowned scientists (Vierhaus 1990; vom Brocke and Laitko 1996; Hachtmann 2007, vol. 1: 81–137). The KWG was expanding noticeably and established a total of twenty-three research institutes within two decades. Many of these institutes focused on material research (coal, iron, fiber, metal, leather, and silicates), which was of great interest for companies, especially for small ones unable to afford their own big laboratories.

The expansion of the Kaiser Wilhelm Society demonstrates that World War I and the demand for research in the name of national defense served as a catalyst for this new level of public engagement in science policy and research planning (Maier 2007: 9). Neither the pitfall of Fritz Haber's scientific contribution to poison gas and German warfare nor the cultural controversy over the means and ends of science and technology during the Weimar years hindered politicians and scientists from pursuing a research policy that took the interests of the private sector into account and expanded the financial aid for scientific research.[4] The financial and economic crises in postwar Germany spurred the initiative for a new funding organization for science, the Notgemeinschaft der Deutschen Wissenschaft (Emergency Association of German Science)—the predecessor of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), which became a cornerstone of German research policy. Although it was primarily financed by the government, its establishment in 1920 was the result of negotiations between leading natural scientists, ministry officials, and private stakeholders (Marsch 1994: 44–60, 84–95). In parallel, representatives of German industry launched another foundation, the Stifterverband für die Deutsche Wissenschaft (Donors' Association for the Promotion of Humanities and Sciences in Germany, thereafter Stifterverband), which acted as an additional private fundraiser collaborating with the Emergency Association of German Science (Schulze 1995: 59–83). Yet German research policy had to meet conflicting requirements after World War I.

On the one hand, German science policy presented science as a cultural asset. Because of the scientific engagement in warfare and the following diplomatic isolation, the German scientific community worried about losing its position as an important international hub for academic exchange. In fact, due to the military relevance of science, the Treaty of Versailles imposed restrictions upon German research. In the Weimar Republic, especially scholars in the humanities referred to the nineteenth-century Humboldtian idea of a university, which comprised the ideal of pure science and a universalistic understanding of education as a counterpoint to a specialized scientific-technologized world (Paletschek 2002: 191–195). Furthermore, the German attempts to catch up with international science, for instance, by collaborative scientific expeditions and research projects abroad turned research policy into cultural policy, which served as an instrument to rebuild foreign relations by other means.

On the other hand, German politicians and scientists hoped to overcome the postwar economic crises and the debts of reparations by research and innovation. In a period in which research policy was mainly aligned with national needs, the ideal of pure science with its academic claim of exclusiveness seemed to be less useful for communicating to the public the need for additional financial support of research. The increasing demand for project-oriented funding crossed institutional boundaries and stimulated a new language of national science policy.

In 1920, the Emergency Association launched a funding program to advance public health, the economy, and the greater public good (Schmidt-Ott 1921, [1925] 1968). At the beginning, this program focused on research in the natural sciences. From 1925 onward, it operated under the name *Gemeinschaftsarbeiten,* which became a new and powerful concept for German research policy. The joint efforts of researchers from different disciplines and institutional backgrounds—universities, industry, and the new institutes of the KWG—aimed at helping Germany to recover economically. Given the scarce financial resources during the Weimar Republic, collaborative work stood for the attempt to rationalize the production and exploitation of scientific knowledge.

According to the historian Jochen Kirchhoff (2007: 206–207), the organizers of the Emergency Association deliberately borrowed the concepts of "collaborative work" and "collaborative research" from U.S. research policy. In the context of technical sciences, the concept of collaborative work actually emerged already before World War I, but it became more common only after the Emergency Association had started to use it as a category of research policy.[5] Striving for national resurrection after the lost war, it was the symbolic meaning of "collaborative" that made the concept particularly attractive to German science policy advisers. Thereafter, they promoted science as a national project, which was, however, not exclusively technology-driven. The program also defined science as a cultural value. This was necessary to shake off the image of the German aggressor equipped with high-technology weapons and to rebuild international affairs based on scientific exchanges and international cooperation. Overall, the Emergency Association intended to restore Germany's national identity and its economic strength (Kirchhoff 2007; Flachowsky 2008: 46–109).

Research Policy in the Nazi Period

After the National Socialist Party took over power in 1933, the ideal of pure science definitely faded. At the very beginning of their reign, the Nazi Party did not show much interest in research policy at all. On the contrary, representatives of the Nationalsozialistischer Deutscher Dozentenbund (National Socialist German University Lecturers' League), which represented the younger generation of lecturers attempting to bring German universities into line with Nazi ideology (Grüttner 2002; Nagel 2008), attacked the established scientific elite. They denounced the nineteenth-century humanistic notion of academia as a selfish project pursued by the liberal bourgeoisie that had estranged science and scholarship from the German people (Henkel 1933; Krieck 1933). However, the attitude of National Socialists toward science changed when the government introduced the four-year plan in 1936, which aimed at preparing German society for war by striving for economic autarky and boosting the armaments industry. In 1937, the government installed the Reichsforschungsrat (RFR, Reich Research Council)[6] that operated as a central body for research organizations.

The RFR could easily revive the Weimar funding program of collaborative research as it fitted in with the *Volksgemeinschaft* ideology and with the council's aim to concentrate all research forces for the war plans. Surprisingly, the establishment of the RFR marked exactly the period when the concept of *Grundlagenforschung* (basic research) became a relevant category for the first time in Germany.[7] Together with the new concept of *Zweckforschung* (goal-oriented research), German policy makers introduced a new conceptual pair that followed the funding rationale of the four-year plan to which the RFR had to adjust. Its first president, a military general and a professor of army technology, Karl Becker, defined basic research as science that could not be "commanded and accelerated." He guaranteed, that "as far as researchers and facilities in the institutions in question offer even some guarantee of success," he would abstain from exerting any control over these institutions (K. Becker 1937: 26). The "institutions in question" were institutes of the KWG, which were relevant to warfare or characterized by their close relationships to industry. In return, goal-oriented research, which was meant to build on basic research, had to fit into the schedule of the four-year plan. The term denoted primarily industrial research leading to the development of advanced technology. According to the four-year plan, industry had to be completely transparent about its research activities (K. Becker 1937: 25, 27).

A good example for the bifurcated research rationale after 1936 is the field of aerodynamics and fluid dynamics. Whereas the Aerodynamische Versuchsanstalt (Aerodynamic Experimental Station) in Göttingen was placed under the direction of the Ministry of Aviation, the Kaiser-Wilhelm-Institut für Strömungsforschung (Kaiser Wilhelm Institute for Fluid Dynamics) was entitled to perform "basic research" (Eckert 2017: 213). Both institutes were run by the same person: professor of mechanics Ludwig Prandtl. Furthermore, the KWG adopted the new nomenclature of the Nazis' research policy quite early (KWG 1939: 322; Telschow 1940: 753).

The new language deployed by Nazi officials proved to be important for communicating their research policy to both the scientific community and the public. The distinction between "basic" and "goal-oriented research" indicates that policy makers accepted, to a certain extent, the autonomy of scientific research: science as a whole could not be conducted according to a strict plan. This autonomy ended, of course, when it came to staffing policy (Schüring 2006; Orth 2016). Moreover, it required German scientists willing to serve the goals of autarky and warfare. In press campaigns promoting German research efforts, officials intended to demonstrate how German scientists, whose work was less visible, contributed—through basic research—to the public good during wartime.[8]

Besides addressing German scientists, science policy experts used the new conceptual pair to reflect on how increasing industrial demands for research affected the institutional setting. Even before 1933, under the paradigm of rationalization, experts deliberated upon the proper way of organizing research in order to quickly achieve societal and technological progress without duplicating efforts in both academic and industrial research. The fact that big companies conducted more and more research in their laboratories raised the problem that good salaries in industry attracted increasing numbers of talented researchers. The future role of universities as training and research institutions and the division of labor between academic and industrial research thus became vital questions of research policy. Furthermore, the changing research practices also led to a discussion about the advantages of individual or team research. The terms "basic research" and "goal-oriented research" were part of these ongoing negotiations (Drescher-Kaden 1941: 10, 16–17; Verein Deutscher Chemiker 1943; Stadlinger 1944: 227, 229; see also Orlans 1969: 114–115; Strupp 2001: 2).

In the end, however, scientists needed some time to adopt the new nomenclature of Nazi research policy. When "basic research" became more widespread after 1939, two things were striking. First, the term primarily appeared in fields of the natural sciences that were close to technical application or at least promising for military, economic, and political aims. Second, most scientists mentioned *Grundlagenforschung* and *Zweckforschung* in the same breath to stress the necessity of both "basic" and "goal-oriented research." Whenever it came to explicitly defining terminology, they depicted basic research as the study of nature, devoid of any concrete notion of how it might be applied. Yet having just drawn such a distinction, scientists immediately strove to emphasize that basic research could not be narrowed down to certain research practices and institutional settings, whether in the industry, in universities, or in other research institutions (Bauermeister 1938; Ostwald 1942: 130–131; Niemeier 1944: 106–107). Furthermore, scientists often criticized the distinction between basic and goal-oriented research as misleading because it suggested that basic research was far removed from any notion of useful application (Endell 1942: 113; Ostwald 1942: 130–131; Zenneck 1944: 10). Only a few scientists actually recognized the semantic shift from pure science to basic research and criticized the new term for constraining science to technological ends (Richter 1943: 207).

The way scientists defined "basic research" must be seen as a vestige of scientists' former understanding of science as contemplating nature and its difference from technology. The interdisciplinary research field of forestry is a good example, as it represented a utility-oriented notion of science first and foremost. Forestry research promised more profitable cultivation and effective technical treatment of wood as a raw material. Germany's rise as a colonial power in the late nineteenth century had already transformed forestry into a politically and economically significant discipline, fostered by the German state. In the four-year plan and during the war, the issue of raw materials, and with it the supply of wood, gained even greater importance (Steinsiek 2008). In forestry, basic research and goal-oriented research represented two equivalent subareas of the discipline: one studied the nature of the substance wood—for example, the physiology of trees—and the other analyzed trees' material properties and the effects of technical treatment. The overall goal of both research fields was to acquire knowledge about the optimal use of wood as a resource for the economy (Runkel 1942: 305–306).

The fact that scientists highlighted the utility of research in general can be understood as a strategy to secure financial support for their respective research fields. However, one question remains unanswered: if the classification of research types appeared to have little consequence for the scientific community, why did scientists deploy the new terminology often in a way that appeared reminiscent of the nineteenth-century boundary discourses? Given the uncertain status of scientists at the beginning of the Nazis' reign and the introduction of the RFR as the central body responsible for managing all research efforts, scientists obviously felt the need to renegotiate the conditions under which research was conducted under National Socialist rule.

They therefore adopted the new concepts in a way that enabled them not only to communicate their commitment to the regime, but also to align the science policy of their time to their specific professional interests and goals. Back in the Weimar years, the individual freedom of professors allowed them to meet individual research interests and socioeconomics needs. Given the academic success story of the natural sciences in Germany, the professional ideal of pure science became almost dispensable. Established professors guaranteed the integrity of science by their personal standing and reputation. Facing the Nazi regime and its war preparations, however, the way scientists inscribed nineteenth-century definitions of science in the new concept of basic research suggests that they tried to protect themselves against unrealizable, exorbitant expectations of Nazi policy makers.

In the late 1930s and early 1940s, German scientists insistently demanded more attention for basic research. In doing so, however, they did not aim at returning to the ivory tower of pure science—that is, they did not fight for absolute professional independence that ignored any political expectations toward research. The majority did not oppose the overall political scheme of the Nazi regime. For example, their plea for basic research explicitly referred to research fields that were highly relevant to industry and war plans (KWG 1939: 322; Telschow 1940: 753; Hoffmann and Suhr 1944: 550). Yet they claimed a right balance of basic and goal-oriented research by arguing that research needs time and that the future utility of scientific outcomes is not foreseeable as readily as future societal needs (Thiessen 1938: 730; Ramsauer 1943; Schultze 1943: 201). Recent studies reevaluating German science during the Nazi period demonstrate that, apart from the racist staff policy, researchers were able to perform normal science according to their output (Ash 2006: 34–35).[9]

Most scientists in this fascist period continuously believed in the national benefits of science and its contribution to technological progress, but the concept of basic research also conveyed the experience that the relationship between science and technology was complex and its outcomes hard to predict. With regard to the scientific community, the discursive function of the concept of basic research lay in the possibility of communicating the uncertainty of scientific progress while promising scientific utility in the long run. What was specific to the wartime period was that scientists were seriously concerned that scientific knowledge might run short if researchers aligned knowledge production exclusively with immediate technological needs (Ziegelmayer 1936: 253; Stock 1938: 150–151; Brüche 1944: 113). The key rationale, therefore, can be characterized as an argument of knowledge sustainability, which appeared in a quite similar way in the U.S. scientific discourse during World

War II (Barton and Burnham 1943: 176; Simons 1943: 391; Taylor 1944: 250; see also chapter 3).

Dealing with the Fascist Past and the Democratic Future

Immediately after World War II, the Allies intended to suppress all German research activities that might have been relevant for the development of armaments. The Allied Control Council Acts and the ensuing executive regulations specified by each of the Western occupation zones prohibited any basic or applied scientific research with military relevance (Frowein 1949).[10] It is important to note that the crucial criterion for prohibition was the military potential of research projects, rather than differences between basic and applied research. Moreover, in the immediate postwar period, the nomenclature of German research policy was not yet settled, and therefore different labels categorizing science and research coexisted. From 1950 onward, however, the use of *Grundlagenforschung* increased, while that of alternative terms, such as *reine Wissenschaft* or *freie Forschung,* was stagnating.[11] Organisation for Economic Co-operation and Development (OECD) statistics on research and developments finally led to an international synchronization of key concepts of research policy (Godin 2005). *Grundlagenforschung* and *angewandte Forschung* thus became the predominant synonyms for the English terms "basic and applied research." In the 1960s, however, the concept of *reine Wissenschaft* could still work as a synonym for basic research, but it became less relevant. The semantic pluralism in the aftermath of the war responded to various requirements that concepts of German research policy had to fulfill in the era of so-called Westernization, in which the Federal Republic recovered economically with the financial support of the Western allies and ran through a transformation from fascism to democracy by adopting sociopolitical and economic models of the Anglo-American World (Doering-Manteuffel 2011).

The concepts categorizing scientific research after 1945 can be roughly divided into two groups. The first includes terms like *Grundlagenforschung, reine Wissenschaft, reine Forschung, freie Forschung,* and *freie Wissenschaft.* These concepts were described as theory-laden and more oriented toward acquiring new knowledge in and for science rather than toward external concerns. The second group encompasses concepts characterized by practical orientation, such as *angewandte Forschung, Anwendungsforschung, Industrieforschung,* and *Zweckforschung.* The meanings of these concepts were partly overlapping, and attributes from older concepts (such as pure science) reverberated in the new terms (such as basic research); even the distinction between the two groups of concepts was fuzzy or contested. As a result, intermediate terms such as "application-oriented basic research" emerged (Stifterverband für die Deutsche Wissenschaft 1967).

Although actors involved in research policy were aware that it was difficult to draw a line between basic and applied research in practice, a normative hierarchy was nevertheless established in the 1950s. Accordingly, research activities labeled as "pure," "free," or "basic" research were given more prominence in public discourse compared to activities defined as "applied" or "goal-oriented" (Trischler 2006: 237). The hierarchy was visible as well in debates about the societal and political role of science, the legal status of science, the organization of research, and the funding policies of government-financed or private foundations. Against the background of the experience with the former fascist regime, the Federal Republic's *Grundgesetz* (GG, Basic Law), that is, the new constitution enacted in 1949, guarantees that "science," specified as "research and teaching," is "free" (GG article 5, paragraph 3). Against this legal backdrop, the debates on independent research mainly revolved around universities and their academic personnel—an exclusiveness that only a few years later was challenged by other institutions of higher education (Dirks 1958: 22–23; Fiege 1959: 87; Bettermann 1963: 69).

The notion of freedom of science held different semantic facets (Wilholt 2012). Legal experts in the late 1950s were pondering whether this article could be interpreted as a government-sanctioned guarantee for the existence of universities—a sort of fundamental law of German universities—as these were seen as the central arena where independent research could be conducted (Köttgen 1959). These experts, as well as other scholars, traced the idea of academic freedom back to the origins of the German university and its independent corporate status in premodern feudal society or, as a much older reference, to Greek philosophy (Wilpert 1953: 268; Köttgen 1959: 16–17; J. Ritter 1965: 17). This invention of a tradition of academic freedom, which mostly neglected the different historical rationales of premodern corporative and modern institutional rights of the universities, made the Nazis' efforts of bringing universities into line with their ideology look like a short and exceptional interlude.

Referring to epistemic reasons, both the scientific community and research-policy experts pled for institutional independence of universities and their teaching staff funded by the German states. In view of the insecure future after the war, researchers wanted to make universities the core of unrestricted, sustainable knowledge production and scientific training. The industrial chemist Walter Reppe, for example, argued that for the sake of progress—he meant both scientific and technological progress—science had to be freed from any practical, political or economic purposes. He warned, "The intellectual foundations of science are in danger! . . . Independent research serves the truth, the advancement of our knowledge, and our cognition" (Reppe 1950: 5; see also Rein 1950: 6; Clausen 1964: 35–43).

The idea of freedom of research and teaching was also framed by a pedagogical discourse of higher education, especially with regard to the training of schoolteachers. Providing the grounding for higher education, *Wissenschaft* was meant to be detached from all practical considerations or material goals in order to focus on the cultivation of human understanding (Stein 1947; Müller 1958: 557; Behnke 1959; Baumgarten 1963). In contrast to the epistemic and pedagogical legitimization, the interpretation of freedom of science as a specific variation of the personal freedom of opinion was less common and became only more important in the period of the German student movement in the late 1960s.

Contemporaries in the 1950s considered *freie Forschung* to be an indispensable characteristic of pure science—an attribute that was, of course, also transferred to the concept of basic research in the following years. After the National Socialists had discredited the old ideal of pure science, its revival in the 1950s functioned as a marker for the break with the fascist past. It referred to the heyday of the German university in the nineteenth century. At the same time, the ennobling idea of scientific research for its own sake was now exploited as a democratic symbol by presenting pure science as part of a humanistic worldview and the common good of humankind. Educated elites (*Bildungseliten*) evoked the German neohumanist-idealistic tradition of science, primarily associated with plans for the University of Berlin conceptualized by Wilhelm von Humboldt, who was the Prussian minister of cultural affairs and education in the early nineteenth century. Yet, industrial representatives also supported this ideal of higher education (Kost 1956). The idealization of Humboldt's plans—the so-called "Humboldt myth," which can be traced back to the early twentieth century (Ash 1999; Paletschek 2002)—turned the university into the center of pure, independent science encompassing freedom in research and teaching. Moreover, the Humboldt model included the claim for unity of research and teaching, the goal of general education (*Allgemeinbildung*), and the ideal of the unity of science—that is, the unity of the humanities and the natural sciences (Schwarz 1957). Addressing the future of the German university in 1945, philosopher Karl Jaspers (1946: 18–21, 104–105)[12] retrospectively identified the increasing dominance of a positivist and utility-oriented understanding of science as an academic pitfall.

The literature has already put this notion of the German university in a historically critical perspective—with regard not only to Humboldt's impact on German university tradition but also to the actual implementation of the Humboldt model in postwar Germany. The drawback of the reference to the nineteenth-century university ideal was a restoration of the power held by full professors, and this was known in Germany as *Ordinariensystem,* which actually hindered the democratization of German scientific institutions and the early integration of young academics (Clausen 1964: 6; Weisbrod 2002: 20; P. Wagner 2010). Nonetheless, the "Humboldtian" notion of science gained importance in postwar Germany[13] because, first, it denoted science as a cultural asset and, second, it again tied science closely together with education in order to transform higher education into a school of democracy and a bulwark against fascism (Baumgarten 1963; Holzapfel 1963). The idea of *Allgemeinbildung,* implemented with formats such as *Studium Generale* (Wolbring 2014: 309–321), also applied to some extend to *Technische Hochschulen,* which presented a culturally defined understanding of technology as their new leitmotif (Schmidt 2014: 82–84).

In a similar vein, scientists and scholars claimed that pure scientific research always had to be based on higher moral principles and philosophical deliberations (Jaspers 1949: 11). Hence, scientist often used the concept of pure science when they were reflecting ethical aspects of research and the philosophical problem of objectivity and truth (Hennemann 1947: 10; Schwarz 1957: 26).[14] German natural scientists complained that ever since materialism gained importance in the second half of the nineteenth century, "pure" empirical sciences has been constantly drifting apart from the humanities (Hartmann 1955: esp. 35–36). According to the biologist Max Hartmann (1953: 614), former director of the Kaiser Wilhlem Institute (KWI) for Biology during the Nazi period, only a combination of "ardent eros of knowledge" and "cold, clear logos," together with a "moral sense of responsibility," could restore the freedom of science. Although most scientists and scholars avoided referring explicitly to examples of scientific contributions to Nazis' warfare and racist policies, this debate must be seen against the background of the fascist past.[15] An exception was the physician and representative of early psychosomatic medicine Viktor von Weizsäcker. Weizsäcker, whose role during the Nazi period is still being discussed controversially (Roth 1986; Jürgen 1996), dealt explicitly with Nazi eugenics in medical research. He pointed to the destructive effects of scientific applications in the service of war and the Holocaust and warned that pure science and its belief in objectivity had become detached from humanitarianism (Weizsäcker 1948: 14–15).

This discourse on the problems of pure science took a slightly different turn in the beginning of the Cold War, when the threat of a nuclear war became a new negative symbol for what science can do. Whereas natural scientists and philosophers pointed to the fallacy of pure science, sociologists perceived pure and independent science to be at risk due to increasing industrial and military demand for research. Social scientists identified the modern political and economic powers as a challenge that corrupted the core rationales of science and its productivity (e.g., F. Wagner 1964: 86–91). Confronted with the consequences of atomic research, physicists such as Carl Friedrich von Weizsäcker and Werner Heisenberg, leading German scientists who had been part of the uranium project during the war, drew another conclusion from the ambivalence of modern science. They stuck to the difference between science and technology—that is, pure science and its applications: "The effects of science on our world are largely effects of technology, which have been brought about by science" (Heimendahl and Weizsäcker 1965: 10). However, Weizsäcker did not use this argument as a relief strategy for scientists. Given the inevitable ambivalence of modern science, physicists called for political action; specifically, scientists should assume responsibility, get involved in politics, and use their scientific expertise to inform the public about risks of modern technology (Howe 1959; Heimendahl and Heisenberg 1965: 52–53).[16]

At the same time, not all scientists discussed the ideal of pure science in this differentiated way. Under the auspices of denazification, it became important for German scientists to distance themselves from the fascist past. At this point, the purity metaphor and the distinction between pure science and its applications turned into a professional strategy to set aside any political or moral responsibility. For the special case of mathematics, Herbert Mehrtens pointed to the semantic flexibility of "pure," which functioned both as a strategy of scientific autonomy and as a label for moral and political innocence of mathematicians (Mehrtens 1994). In most of the documents and self-testimonies whitewashing German scientists after 1945 (so-called *Persilscheine*), semantic variations of the argument that scientists followed their pure devotion to the advancement of scientific knowledge played a crucial role (Proctor 2000: 10–11; Heim 2002; Sachse 2002).

Moreover, the notions of pure or true science were still important for the professional identity of natural scientists. They were quite common in proceedings and addresses on the occasion of academic festivities or inaugurations of new institutes. Most of these speeches entailed retrospectives on German science before the world wars, portrayed as a time when pure devotion for the advancement of scientific knowledge was still possible (F. Becker 1950: 529). When Lise Meitner (1964), for example, remembered the beginning of the KWI for Chemistry before World War I, she was missing "the happy time of pure science, when scientists had not to think of the dangerous applications of their scientific outcome." Especially the reestablishment in 1950 of the Gesellschaft Deutscher Naturforscher und Ärzte (Society for German Naturalists and Medical Doctors)—the most famous and influential German science association in the nineteenth century—can be seen as a symbolic act of evoking the ethos of pure science, the beginning of scientific professionalization, and the unity of natural scientists (Degen 1954, 1956; Pfannenstiel 1958: 1–2). In obituaries and laudations, the attribute "pure" kept on being an essential marker for scientific accomplishments and the individuals' contributions to scientific progress (Laue 1951: 515). Accordingly, a "born scientist" was characterized by his or her "pure quest for knowledge" (Henke 1955: 193).

All in all, the attributes "pure" and "independent" were entwined in different ways. Yet in order to work as a democratic symbol, the resulting concept of science had to be backed up by the commitment to a humanistic worldview. Hence, against the historical background of the Nazi regime, the image of science being independent from political and other external influences was generally important for all nonprofit research institutes—not only for universities. With the beginning of the Cold War, however, the democratic underpinning of science also became vital for the political boundary work of the Federal Republic as well. Because of the competition between the two political systems, West German policy makers and experts started to put the G.D.R.'s science policy under scrutiny (Lange 1955). Heinrich Kost (1956: 26–27), a leading representative of industry, business, and trade associations, thus turned the ideal of freedom of science into an ideological argument for the necessity of protecting Western culture from Communism:

> There is no doubt: striving exclusively for short-term material benefits inadvertently undermines our Western model of civilization. There is only one force that will be pleased by such a development: bolshevism, which puts an end to the freedom of science as much as it abolishes the freedom of economic activity. . . . Against this background, the voluntary promotion of scientific research, teaching and training appears to be the ideal instrument for protecting the freedom and independence of science, which we know to be no less vital for our civilization than the protection of private property, economic or personal freedom.

U.S. science policy experts visiting Germany after the war enforced this Western perspective on Eastern research policy by contradicting the communist argument that "pure science" was a "myth of the bourgeoisie, a legend of capitalism" (Conant 1953: 7). The U.S. democratic understanding of science was also backed by revived nineteenth-century scientific ideals of freedom and universal humanism (Bender 1997: 4–5). Whereas in the United States, the writings of Robert K. Merton (1942) and Michael Polanyi (1962) were prominent references in this ideological debate, in West Germany, Karl Popper's *The Open Society and Its Enemies* became an influential scholarly reference. The book of the British scholar, who had emigrated from Austria in 1937, was published in 1944 and translated into German in 1956/57. According to Popper, no form of "closed societies" could ever breed a critical, and therefore true, knowledge-aspiring science (Popper 1958: 275–319; see also Hailsham 1961).

Planning for a Prosperous Western Democracy

Notwithstanding the purity talk, after 1950 it was the concept of "basic research" that became more and more popular. In contrast to the Nazi period, in which it was mainly used as a counter concept to pure science, after 1950, "basic research" absorbed the attributes of, and norms and ideals associated with, pure or independent science. This also applied to the ideological dimension according to which a "free society" must promote "basic research" because otherwise it would risk becoming "primitive" and prone to materialist-communist tendencies (Strugger 1956: 5). At the beginning, however, scientists seemed to be puzzled by this semantic transfer. Some preferred conceptual hybrids such as "free and pure so-called basic research" in order to make sure that exactly these attributes were included (Reppe 1950: 7; similarly, e.g., Holdermann 1949: 161; Bianca 1950: 2).

Only few scientists in the immediate postwar era refused to follow this semantic shift. August Thienemann (1949), a zoologist and member of the Academy Leopoldina, strictly rejected the concept of basic research:

> It is supposed to lay the basis—for what? . . . It is contrary to the German spirit to degrade science in its entirety to the role of maidservant of practice. That is why the term "basic research" has to disappear, and the general public needs to be reminded over and over again of the value of theoretical, pure science for its own sake. This is particularly important in times of hardship, when it seems so obvious to put material considerations above intellectual concerns.

It was, however, the metaphorical use of basic research that actually did the trick for communicating to the public the need for government support of science. The advantage of talking about "basic research" was that one could promise the advancement of scientific knowledge as well as economic and societal progress. In line with the argumentation that is known from U.S. science policy discourse following the so-called Bush Report, "basic research" was supposed to lay the ultimate ground for technological innovations and national welfare. The idea, of course, was not new. The assumption rested upon the nineteenth-century idea that the discovery of only a few laws of nature would provide plenty of applications in the future. A slogan widely used in the 1950s expressed this expectation: "die Forschung von heute ist der Fortschritt von morgen"—today's research will be tomorrow's progress (Gross 1955: 34; Gerlach 1956: 31; Hess 1962: 31). Even natural scientists who particularly clung to the ideal that science should be performed only for its own sake, such as the chemist Otto Hahn (1949, 1954), felt the pressure to promote academic research by promising technological or economic progress. The reference to the idea of laws of nature in this context is surprising since this strict understanding of causality had already lost its epistemic relevance in the wake of quantum theory (Engler 2010). Even more, the rhetorical power of the revived idea of scientific laws stresses once again how older attributes of science were adapted to contemporary expectations toward academic research after World War II.

The popularity of basic research in the Federal Republic of Germany was partly due to the promotion tour by prominent U.S. scientists and policy advisers. For example, the former president of Harvard University, James B. Conant, came to Germany in 1953 as a high commissioner and argued for the necessity of fostering basic research and, therewith, for the support of autonomous research as an essential contribution to industrial progress (Conant 1953: esp. 7). The Stifterverband, which remained an important fundraiser for scientific research until the 1960s and an intermediary between science and the economy,[17] published translations of such speeches and texts written by American scientists. Next to Conant, the most prominent author was presidential science advisor Vannevar Bush, who famously had been among the first to call for federal funding of basic research. His slogan "The research of today and the world of tomorrow"—translated as "Die Forschung von heute und die Welt von morgen" (Bush 1954)—was echoed many times in the Federal Republic. This plea meant more than lip service; the United States actually financed a lot of research in Western Europe. John Krige argues that this basic-research mission played a key role in reconstructing European science under "American hegemony" for two reasons. First, the concept was important for communicating the U.S. financial support for the former wartime enemies to the American public without raising concerns. Second, the United States promoted basic research as unclassified research in the allied countries to increase its stock of scientific knowledge and thus to secure American technological leadership (Krige 2006).

The call for more basic research was mainly driven by worries that research that cannot promise immediate applicable results would be neglected. This argument was partly taken over from the U.S. debate and partly derived from the German discourse on catching up with the leading nations of the West (Arnold 1956). Overall, the promotion of basic research aimed primarily at research in the natural sciences executed at universities. According to the research experts, "basic research" should have been reserved largely for universities and *Hochschulen* and considered as "a sort of stockpiling" for economic prosperity and national welfare (Reppe 1950: 6; see also Klar 1959: 77).

In the 1950s, experts were actually concerned about the sufficient funding of German universities and, as a consequence, their autonomous status (Heppe 1956). In the end, it became an international consensus of the OECD nations that universities are centers of basic research (King 1964: 4).

In the Federal Republic, the central funding organization for academic and independent research was the Deutsche Forschungsgemeinschaft (DFG). It was reestablished in 1949 and operated until 1951 under the name of its predecessor, the Notgemeinschaft der Deutschen Wissenschaft, and was mainly financed by both the federal government and the German *Länder,* with additional support of the Stifterverband. Although public debates on research at universities were closely linked with the ideal of basic research, the DFG mostly avoided speaking of basic and applied research in the 1950s and 1960s. Moreover, the DFG clarified that it supported not only both the natural sciences and the humanities but also "pure and applied research" (DFG 1955: 10).[18] The statutes defined the purpose of the association as a service for "science in all its branches" (DFG 1961b: 214). In the 1950s, the DFG obviously felt compelled to defend its funding policy and argued that the American plea for more basic research had to been seen against the backdrop that the United States spent 90 percent of its governmental research budget for "applied research" and thus needed to increase the stock of knowledge in the natural sciences (DFG 1955: 10–11). While the United States had its governmental research institutes, according to the DFG, Germany had none. However, the DFG adopted the metaphor of "basic," at least, in some way: "It [the DFG] supports all branches of research and thus lays the scientific fundaments for required public provisions serving the common welfare." Here, the freedom of science, guaranteed by the Basic Law, was legitimized by the service for the common good, which is another facet of the meanings of academic freedom (DFG 1961a: 12, 13).

The DFG failed to explicitly define its understanding of "applied research." The overviews of the spending in the 1950s placed the agricultural and technical sciences (*Technik*)—that is, fields that could be defined as applied sciences in the traditional sense—as additional categories beside the natural sciences, the humanities, and medicine. With regard to agricultural sciences, a report of 1951 explicated that the Notgemeinschaft der Deutschen Wissenschaft (1951: 27) had so far funded only basic research, whereas applied research projects were meant to be funded by the Ministry for Agriculture. In general, the natural sciences got the largest share of the total DFG funding budget—48 percent in 1955, whereas technical research fields got only 12 percent in the same year (DFG 1957: 35). In 1953/54, the DFG installed a Committee for Applied Research to improve support for technical and agricultural research. In this context, the DFG explained that it had focused on basic research so far because applied research had been expected to attract more financial support from industries. The justification of the new committee reveals, in other words, that academic research in the natural sciences was conceived as synonymous with basic research (DFG 1957: 58–59).

After all, there are two reasons why the DFG did not feature basic research as a pivotal funding rationale in the first two decades after the war. First, the funding organization was responsible for supporting research at both the universities and the *Technische Hochschulen*. Second, the distinction between basic and applied research had not been relevant to the humanities, the social sciences, economics, or medicine and was only rarely used in these areas by then (DFG 1957: 58). In self-descriptions of the DFG, the concept of basic research became more common only in the 1970s. According to the report of 1974, the funding rationale focused on "basic research and research close to application [*anwendungsnahe Forschung*] carried out at institutes of higher education [*Hochschulen*]" (DFG 1975: 9). Since the economic crisis of the early 1970s had resulted in budget cuts, it became harder to justify spending on academic research. In contrast to former reports that praised the principles of independent open science, the aspect of research planning according to economic criteria gained importance. It seems that this was the time when the idea of basic research as the first stage in a linear process of innovation started to take center stage in the DFG's efforts to communicate research policy to the public (DFG 1972: 17).

Along with the universities, the Max-Planck-Gesellschaft (MPG, Max Planck Society) was considered a privileged venue for basic research. In its statutes from 1949, the MPG described itself as an association of independent research institutes (*freie Forschungsinstitute*) and emphasized its autonomy from the state and industry. As a self-governing body, financed mainly by public funds, its autonomous status was guaranteed by the Basic Law and meant institutional autonomy as well as the autonomy of the individual scientist. Although the ideal of basic research was not recorded in the statutes, it turned into a pivotal marker for the scientific identity of the MPG.[19] In the 1950s, scientists of the MPG, such as Nobel laureates Otto Hahn (1953) and Erich Regener,[20] stressed their focus on autonomous basic research whenever they wanted to emphasize their independence from politics and the economy while at the same time promising future economic benefits. It was exactly this semantic shift after 1945 that made it possible to invent a continuous tradition of independent, pure "basic research" from the Kaiser Wilhelm Society to its reformation as the Max Planck Society (Biermann 1961). Due to this rhetorical capacity, the label of basic research fit also those MPG institutes that were engaged in research fields close to technical applications, such as the Max-Planck Institute for Metal Research. In return, it worked equally when the institutes of the MPG applied for funding from the European Recovery Program (ERP), which explicitly aimed at projects promising short- or medium-term applications. The Max Planck Institute for Chemistry, for instance, ensured that its work would offer a broad range of opportunities for application in the future, in particular with respect to "biomedical, agricultural, and heavy-industrial chemical areas of research."[21] It received a generous sum from the ERP,[22] even though its scientists never pushed its research toward these fields or other more application-oriented ends (Reinhardt 2012).

The Emancipation of Applied Research and Engineering Sciences

When German scientists and policy makers were talking about basic and applied research after 1945, it became a habit to emphasize that it was hard to draw a clear line between the two of them. There was, however, also more serious critiques with regard to the implicated superiority of basic research over applied research. To begin with, the purity discourse on science had moral implications. As it has already been observed for the United States, the label "pure" conveyed evaluative elements that suggested that applied or goal-oriented research was in some way "impure" (Kline 1995: 217; Kaldewey 2013: 360). In the same line, some German researchers pointed to the "emotional tone the term 'pure' implicates." In their view, applied science was neither comparable with contract research nor less scientific than basic research (Wenke 1957: 44, see also 43).

Especially the engineering sciences felt offended by the increasing requests for a privileged support of basic research. For example, in 1950, Richard Vieweg, who served as president of the Physikalisch-Technische Bundesanstalt (Federal Physical-Technical Institute) and chairperson of the Deutscher Verband Technisch-Wissenschaftlicher Vereine (German Union of Technical-Scientific Associations), problematized the insecure position of applied or engineering sciences within academia. In particular, he worried about their chances of getting public grants while competing with the basic sciences—that is, the natural sciences (Vieweg 1950: 731–732; Sörensen 1952: 158). Vieweg criticized the partitioning of basic and applied research that was pushed by several parties as not only being motivated by the desire to classify the two but also implying favor of the former over the latter (Vieweg 1955). With reference to the unity of science, symbolized by the tree of knowledge, critics of the ideal of basic research claimed that basic and applied research benefited from each other. They argued that technology and applied sciences opened new scientific horizons far beyond the knowledge required for solving the original technical problem. In this sense, applied research could stimulate basic research (Houdremont 1953: 39–40).

Another challenge came from the industrial researchers, who did not accept the common assumption that basic research was restricted to the academic sphere. Instead, they pointed to the efforts industry had made so far in basic research and explained how basic and applied research intertwined within industrial laboratories (Houdremont 1953; Steimel 1963). Besides, these experts knew that investment in research could increase the prestige and reputation of companies; as one industrial representative put it, “Research is the golden framing of a company’s business card” (Steimel 1963: 9). After all, the public funding of science at universities was not against the interests of industry, since it secured the training of future industrial researchers and spared them from doing risky research with unpredictable outcomes.

The criticism of the basic/applied distinction finally left its mark on the nomenclature of research policy. With the creation of compounds such as *angewandte Grundlagenforschung,* engineers tried to prevent the neglect of applied sciences (Heiss 1950, 121; Wever 1952: 1053). Later, the Stifterverband mentioned the semantic variation *anwendungsorientierte Grundlagenforschung,* defined as basic research that is inspired by its practical relevance, in its list of established concepts of research policy (Stifterverband für die Deutsche Wissenschaft 1967). In the end, such intermediate categories did not become as common as the antonymic terms “basic and applied research.” Notwithstanding the success of the basic research narrative, the criticism at least activated a debate on how to improve the support for applied research. Already in 1949, the Fraunhofer Gesellschaft zur Förderung der angewandten Gesellschaft (FhG, Fraunhofer Society for the Promotion of Applied Research) was founded. However, the goal of this new organization and, as a consequence, its legitimation remained unclear until the mid-1950s (Trischler and vom Bruch 1999: 38–39). It thus took a while until the FhG, focusing on contract research for industry and public administration, advanced to being the biggest German organization for applied research.

Another attempt to increase the promotion of applied research was made by the DFG. In 1953/54, a permanent Ausschuss für angewandte Forschung (AfaF, Committee for Applied Research) was established and run by representatives from the *Technische Hochschulen* and industry, as well as ministry officials (Lax 2015: 163–79). The AfaF played an important role until well into the 1960s. At the beginning, the main goal of the AfaF was to take stock of the different fields of applied research and to assess which areas were in need of support. The report pointed to specific fields, such as shipping and aviation, and highlighted the MPG as an example of excellent cooperation between industry and research institutions (DFG 1956: 9). In 1957, the AfaF became an advisor for the newly established Wissenschaftsrat (German Research Council). Overall, the AfaF was meant to coordinate industrial requests for research and agendas of academic research. The first AfaF memorandum defined "applied research" as a combination of basic research seeking to understand the laws of nature (*Naturerkenntnis*) and technical research leading up to product development (DFG 1956: 7). In preparation for the AfaF, Kurt Zierold, general secretary of the DFG, pointed to a U.S. funding classification according to which "pure research" and "fundamental applied research" were meant to be funded by the government, while "applied research" and "development" should be financed by both industry and government.[23] By the late 1970s, the committee no longer met regularly and lost its relevance. It seems that the status of applied research was no longer controversial and its funding was secured.[24]

Overall, the ideal of pure, independent research in the immediate aftermath of World War II was challenged by the necessity of economic recovery within the Western alliance. Even proponents of the ideal knew that compromises had to be made between granting the greatest possible autonomy in the allocation of resources and the individual choice of research topics on the one hand, and the response to societal or economic needs on the other hand (Raiser 1950: 3; Tellenbach 1954: 11). As a result, German science faced a process of reorganization that reached its peak at the end of the 1960s. The awareness that even autonomous institutions were in need of planning led the DFG to launch new funding formats, such as interdisciplinary, collaborative research programs (*Sonderforschungsbereiche*)[25] (Orth 2011: 96–238). In parallel, the West German government and industry started with big science projects, as other states had done before (G. Ritter 1992; Mutert 2000). In this phase of growing research planning, the imagined relationship between basic and applied research changed to some extent. Against the background of the economic crisis in the 1970s, scholars from the Max Planck Institute in Starnberg suggested that advanced research fields of basic research should turn to more application-oriented research to speed up the knowledge transfer from basic to applied research—an idea that came to be known as the "finalization thesis" (Böhme, van den Daele, and Krohn 1973). Yet, in the end, such suggestions indicated the persistent belief in basic research providing the ultimate ground for all kinds of technological innovations. Moreover, the concepts of basic and applied research definitely took hold because they proved to be relevant for the communication of research planning.

Conclusion

What is special about the way science was categorized during the changing German science policy regimes? At first sight, the German scientific community in the second half of the twentieth century embraced the basic research ideal as enthusiastically as it embraced the pure science ideal in the nineteenth century. Still, while the ideal of pure science gained prominence quite early in the nineteenth century, the concept of basic research received ambivalent responses in the 1950s and 1960s and prevailed only later as the official funding rationale. Both phenomena point to the specificities of German academia.

To begin with, when natural scientists entered German universities in the first half of the nineteenth century, they adopted the predominant philosophical ideal of pure science and turned it into a successful strategy of professionalization and boundary work facing the upcoming engineering sciences. In Britain as well as in the United States, in comparison, the idealization of pure science gained importance not before the 1870s. Although all idealistic notions of pure science had in common that their promoters turned technical inventions retrospectively into success stories of science (Gooday 2012), it was the epistemic underpinning that characterized the German distinction between pure and applied research. In contrast to the United States, the German understanding of pure science was less morally charged (Lucier 2012). Yet it still implied a stricter hierarchy between pure and applied science than in England (Bud 2014).

In the early twentieth century, the ideal of performing science for its own sake was challenged by the rising societal expectations in view of industrial applications of scientific results. Governments realized that science policy was more than a higher education policy and thus developed an interest in a research policy aligned with national economic interests. Hence we witness a period of semantic transition, in which new concepts emerged. In the United Kingdom, ministry officials used the neologism "fundamental research" to convince scientists to cooperate with industry, and, in turn, to persuade companies to build up their own research laboratories (Clarke 2010). In the United States, the new term "basic research" came up in the context of agricultural research and debates about its public funding (Pielke 2012: 340). In Germany, both government and industry gave money to found new independent research institutes run by the KWG. Here, the cooperation between academic science and industry worked successfully without compromising the scientific reputation of its leading scientists. Furthermore, facing the financial crisis after the World War I, Germany established a national research foundation. Although contemporaries still considered science a cultural value in itself in the 1920s, the concept of pure science did not suffice to communicate the coordination of different institutions performing research. Under the conceptual umbrella of "collaborative research," German policy makers managed to bring together scientific, economic, and political interests to overcome the national crisis while respecting the academic ideals of the unity of science and the individual autonomy of professors at the same time.

It was not until the late 1930s that the new concept of basic research became more popular in German research policy. The National Socialist Party, which had discredited the ideal of pure science as a selfish project of the bourgeoisie that had estranged academia from German society, used the term "basic research" to describe research projects that were most promising for furthering their war plans and their idea of economic autarky. The concept enabled policy makers and scientists to communicate both the promise that science would lay the cornerstone for technological progress, and the inherent uncertainty of the scientific venture into the unknown.

In the immediate aftermath of World War II, the public debate on science showed a good deal of semantic pluralism. The older concept of pure science was revived and primarily used in a moral sense, either with a critical stance when scientists were deliberating the ethical or epistemic hubris of pure science or in a self-defending way for distancing themselves from the fascist past. Next to pure science, the attribute of independency became even more important because it turned science into a symbol for the democratic transformation of West Germany. Universities and the MPG emphasized their independence from any political or economic interests. With the invention of neohumanistic traditions, freedom of science became a powerful emblem especially for German universities. Under the auspices of democratization in the 1950s, science became more tightly coupled to higher education again. Against the background of the fascist past, the coupling of science policy and education may have been stronger than in other Western nations.

In the 1950s, the concept of basic research became more and more popular because it had taken a semantic twist. While in the Nazi period the term worked as a counter concept to pure science, after 1945 it actually absorbed the ascriptions of pure, independent science. In the Federal Republic, scientists, politicians, and industry shared the belief that it is important to support basic research at universities. They followed the U.S. promotion of the ideal of basic research among the Western allies. The backing of basic research in the natural sciences promised economic benefits and the advancement of scientific knowledge at the same time. The unrestricted production of new knowledge was said to be a kind of economic savings account. Herein lay the rhetorical power of the concept. In contrast to the United States, the concept did not determine the official nomenclature of the reestablished German Research Foundation. In the United States, where the launch of the National Science Foundation in 1950 was a novelty, the concept of basic research functioned as a political symbol capable of integrating different political camps and interest groups (Pielke 2012). In Germany, in contrast, government funding of science had a long tradition. Furthermore, contrary to the NSF, the DFG was in charge of supporting all branches of science, including the humanities, medicine, law, and economics, as well as the applied sciences, right from the start. In the context of the DFG, "basic research" first and foremost denoted academic research in the natural sciences. Yet since the bigger part of the DFG's spending went to the natural sciences, basic research can be seen at least as an unofficial funding rationale. Besides, applied research in the engineering sciences proved to be less dependent on public funding. Only from the late 1960s onward, when the international conceptual synchronization within OECD nations took place (Godin 2005) and the Federal Republic's government began to do research planning on a broader scale, the distinction between basic and applied research finally prevailed as the official funding rationale.

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Notes

1. For the different developments of research policy and the key concepts after 1945 in the Communist German Democratic Republic, see chapter 6.
2. All original German quotes have been translated by the authors.
3. Since there is no translation that really matches the meaning of *Technische Hochschulen,* we use the German term instead of less proper translations such as technical colleges or technical universities.

4. For a more differentiated analysis of the intellectual debates on science and technology during the Weimar Republic, see Panoutsopoulos 2014.
5. The concept of collaborative work emerged at the turn of the century in socioeconomic and pedagogical debates. First mentions with clear references to research defined "collaborative work" as international cooperations in the technical sciences with regard to the testing of material and standardizations of measurements: Exner 1910. The concept seemed to keep its specific relevance for the technical sciences in the following years. According to Karl-Heinz Ludwig (1979), engineers elevated it to a professional ideology during the Nazi period.
6. The RFR was responsible for funding research. During the war, it answered directly to the Army Ordnance Office (Flachowsky 2008: 232–462).
7. The German version of fundamental or basic research had already emerged in the early twentieth century. Before 1937, the use of the term, however, was mainly restricted to the discipline of mathematics and debates on epistemology. Here, the term primarily referred to research on fundamental problems in mathematics (Schauz 2014: 286).
8. *Illustrierte Zeitung,* Leipzig, No. 4956, 22 August 1940. Established in 1843, the *Leipziger Illustrierte* was one of the oldest magazines in Germany and well known for its high-quality prints. In comparison to the very popular *Berliner Illustrierte,* the magazine from Leipzig addressed primarily readers of the middle class and ones with a higher level of education. During the Nazi period, the *Leipziger Illustrierte Zeitung* turned into an unofficial propaganda medium of the National Socialist Party, like many other magazines in this period. For the role of magazines in the Nazi period, see P. Rössler 2010.
9. The history of both the KWG and the German Research Foundation was the subject of two major research projects. See the wealth of research published in the academic series *Beiträge zur Geschichte der deutschen Forschungsgemeinschaft* (Stuttgart: Franz Steiner Verlag) and *Geschichte der Kaiser-Wilhelm-Gesellschaft im Nationalsozialismus* (Göttingen: Wallstein).
10. Kontrollratsgesetz no. 25 from 29 April 1946; Militärregierungsgesetz no. 23 from 12 September 1949. The exact German terms deployed in these two acts were *grundlegende wissenschaftliche Forschung* (fundamental scientific research) and *angewandte wissenschaftliche Forschung* (applied scientific research). The regulations defined military relevance on the basis of several classified research fields. For more details of how the allies controlled research, see Heinemann 2001.
11. According to the database of Google books and its statistical tool, Google Ngram, the use of basic research nearly doubled between the 1950s and 1960s. Alternative concepts, first and foremost pure science—taking all possible inflections of *reine Wissenschaft* into account—were stagnating (period 1945–1960, smoothing 3, German corpus, inflection search). This comparison of how the different concepts diffused does not include concepts such as pure chemistry, which worked together with the distinctive attribute of applied as a label for different subdisciplines.

12. It is most revealing that Jaspers' speech was a new version of an older one he had given in 1923; fifteen years later, he presented an updated version of the same speech (Jaspers 1923; Jaspers and Rossmann 1961).
13. The reference to Humboldt also applied to the G.D.R. Following the Soviet policy by shifting research from universities to the academy of science, however, the G.D.R. abandoned the goal of tying together research and teaching (Paletschek 2002: 200–201).
14. Within the epistemic discourse on theory of science, the concepts of *reine Wissenschaft* and *reine Naturwissenschaften* were and still are primarily used as a reference to Kant.
15. Despite the growing awareness of the dilemmas of modern science, in most cases the Nazi period was defined as an exception, a period of *Befehlsforschung* (commanded research) in which science had been abused (Wenke 1957: 44).
16. For more detailed studies on the political and ethical statements of German nuclear physicists, see Kraus 2001 and Carson 2010.
17. See, for example, the list of donations in Stifterverband für die Deutsche Wissenschaft 1955: 152–153.
18. In the second edition, it was "basic and applied research" (DFG 1957: 8).
19. For a more detailed analysis of the policy of basic research within the MPG, see chapter 5.
20. Archive of the History of the Max Planck Society (MPA, Archiv zur Geschichte der Max-Planck-Gesellschaft), Sect. I, Rep. L 15/-SV, 1949–1968, Map Vademecum: Regener to the MPG, 23 August 1952 and Regener to Telschow, 29 April 1952.
21. MPA, Sect. II, Rep. 1A ID9, folder 2, Marshall-Plan, 1950–1953, General: Declaration of the Max-Planck-Institutes for Chemistry in Mainz, 23 May 1951.
22. MPA, Sect. II, Rep. 1A ID9, folder 2, Marshall-Plan 1950–1953, general and second tranche: List of ERP-funds for institutes of the MPG.
23. Archive of the DFG Office, DFG Committee for Applied Research, 6210 (founding documents), meeting on 23 January 1954.
24. Walter Pietrusziak (Archive of the DFG office) to Gregor Lax, e-mail, 5 July 2013. The AfaF files documenting the late 1970s are not yet accessible.
25. This funding format still applies to all disciplines; it is not restricted to the natural or engineering sciences. The most important collaborative actors were and still are the universities. Cooperation with other research organizations like the MPG or the FhG is also possible. The debates on interdisciplinary research and teaching formats started already in the late 1950s (Schregel 2016).

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